Chapter 2
Land Use Research

Abstract Basic terms, including "land use" and "land cover" are defined. Land use patterns are seen as a result of long-term interaction between humans and natural environment. Practical applications of land use research are discussed, namely with regard to land management and policy and land use planning. Later, the history of land use in the world is outlined. Four scientists that contributed most to land use research in the past are mentioned. First, Johann Heinrich von Thünen, who formulated the intensity theory and theory of crop zones. Second, Karl Marx, author of the term "differential ground rent". Third, British geographer L. D. Stamp who is considered founder of modern land use research. Last, but not least, the Polish geographer J. Kostrowicki who focused on typology and classification of agricultural systems in the second half of the twentieth century. Current approaches in land use research in the world are also discussed. Special attention is given to the DPSIR model that works with "drivers" and "pressures", "impacts" and "responses". The multi-level explanatory scheme, formulated by Scottish geographer A. Mather, is seen as the most complex concept used in land use research so far. Mather worked with proximate, intermediate, and underlying factors and he is also the author of the "forest transition" concept. In Czechia, the first research projects focused on land use were carried out in the early 1960s. At the moment there are two main research directions: analyses of small areas, and complex land use studies carried out by the so-called "Prague school". The latter studies often span a long period of time, starting in late eighteenth century. Old maps are utilized for comparisons; recently also remote sensing data have become available.

Keywords Human–nature interaction · History of land use · von Thünen · L. D. Stamp · Land use factors · DPSIR · Czech research

This research focuses on landscape and its use by humans. "Landscape" is understood as the result of long-term interaction between society and environment. There are several approaches to landscape studies; the difference between

I. Bičík et al., *Land Use Changes in the Czech Republic 1845–2010*,
Springer Geography, DOI 10.1007/978-3-319-17671-0_2

micro- and macrostructure of landscape (Lipský 2000) is seen as crucial. Landscape macrostructure is understood as the share of different land use types (arable land, forests, built-up land, etc.) on the selected area. On the other hand, landscape microstructure includes different landscape elements (for instance small areas, lines and other items) and its size, shape, spatial distribution, and mutual interaction. The social-geographical research in general examines mostly the landscape macrostructure—as does this publication.

2.1 Land Use or Land Cover?

Apart from "landscape", also the expressions "land use" and "land cover" are very frequent and can be easily confused. Thus, we feel that sound definitions are important.

FAO (2000) defines land cover as "the observed bio-physical cover on the Earth's surface". As such, land cover reflects the real (de facto) land cover, in other words what grows on the examined plot, what can be "seen". Land cover is usually examined by means of field mapping or remote sensing; the expression is traditionally used in natural sciences—landscape ecology or physical geography. The approach towards land cover research much depends on the purpose of study which influences classification, legend, scale, minimal size of the grid, etc. To a certain degree, land cover research can be subjective, depending for instance on research teams.

The term land use was first used by Stamp (1948)—see Sect. 2.3. It can be understood as a secondary concept as "land use" also includes the use of "land cover" by humans plus the social, economic, political or cultural "function" of land cover (Aspinall and Hill 2008). As a result, land use is seen either as a human activity as such (physical use of an area) or as an existing situation that reflects human activities in the landscape. FAO (1998) defines that land use "is characterized by the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it". Thus, this expression "establishes a direct link between land cover and the actions of people in their environment". Similarly, Lambin et al. (2006, p. 4) defines land use as "the purpose for which humans exploit land cover". Land use includes "both the manner in which biophysical attributes of the land are manipulated and the intent underlying that manipulation, i.e., the purpose for which the land is used".

Land use reflects the state of the landscape "*de iure*" and it is influenced by the attitude of owners and users, and also by the authorities. Thus, also land use research can be affected by the approach adopted by authorities and owners/users of respective area. Land use researchers usually rely on cartographic and statistical data that are typically used in social sciences, including social geography.

Our approach is closer to "land use" as we mostly use statistical data collected from cadastral registers. In these files, for instance, forest that would grow on a

plot labelled as “permanent grassland” is registered as “PG” until a formal change of land use is made by the authorities; the same, however, may apply vice versa. Since 1850, land owners have been obliged to report such a change to authorities no later than 1 year after it had occurred; in 1990 this deadline was extended to 2 years.

As an example, forest (land use type) often includes temporarily forest-free plots (clearings, roads, swamps, etc.). Paradoxically, forests within national parks that enjoy the highest degree of protection are sometimes formally part of the so called “other areas” (for details see Chap. 5).

The term “land use”, however, is also used in environmental sciences including social ecology (Fischer-Kowalski and Haberl 2007). This approach considers land use being part of “colonization of terrestrial ecosystems” by man. Sometimes, human dominance over ecosystems and human appropriation of photosynthesis products are discussed. Colonization of ecosystems can be explained as planned human intervention in ecosystems (landscape, nature) with the aim to make the system more suitable for use by people. Such a colonization can be analysed through social and economic activities that influence the ecosystems or through changes within the ecosystems that were caused by human interventions (Krausmann 2001).

Ecosystems tend to keep returning towards climax; consequently, humans must struggle to retain the “colonized state” by constant inputs of energy, material, and labour. This is close to the concept of “landscape stability”. Though definitions of landscape stability vary and some scholars even reject the concept as a whole, our approach defines it as a state that is inversely related to the amount of energy, material, and labour invested by the society so that the landscape would stay in balanced state (Lipský 2000).

2.2 Importance of Land Use Research, Practical Use

There are at least two reasons why land use research brings fruitful results. First—given the fact that land use patterns result from long-term interaction between humans and the natural environment, and use research provides information on changes in this interaction, being on the frontier between natural and social sciences. The word “provides” is appropriate here as land use is just a sort of a mirror that reflects human interventions in the environment. It is an important mirror, but it does not tell us much about the nature of the driving forces. As a result, these driving forces behind land use changes and their changing nature must be examined with equal interest.

Second—when it comes to comparison with most other scientific fields—land use research can make use of vast databases containing precise and well-structured data (sometimes even “data surplus” is mentioned!). Thus, outcomes of various land use research projects are highly accurate and provide precise analyses in terms of time, space, and territory.

Historically, the popularity of land use research has been influenced by increasing interest in environmental sciences after World War II, especially during the so-called "environmental decades" (1960s, 1970s). This growing interest has been driven by mounting global and local environmental problems (air and water pollution, soil contamination, deforestation, habitat loss, decrease of biodiversity, soil erosion, ozone depletion, climatic changes, etc.) as well as by changing attitudes in western societies (material well-being, post-materialism). Establishing of the Club of Rome (1968) or the Earth Summit Rio in 1992 which resulted in Agenda 21 can be named as important milestones. This growing interest in sustainable development contributed to more intensive environmental research and to emergence of a whole cluster of sciences that can be collectively called "sustainability science" (Aspinall and Hill 2008). It is a complex issue on the boundary between natural and social sciences that reflects the increasing importance of interdisciplinary approach since the 1990s.

Landscape includes a whole array of natural elements (soil, climate, habitats, biomass production, and natural cycles) as well as many social elements (agriculture, extraction of raw materials, built-up areas, infrastructure). As a result, land use research can form just a part of the above-mentioned "sustainability science": it offers links, interaction, and methodological contacts among social sciences (economics, history, sociology, social, economic, and historical geography), natural sciences (physical geography, biology, landscape ecology, and environmental science) and economic-technological sciences (agriculture, chemistry, mechanics).

The emerging "land-change science" (Lambin et al. 2006) contributes to studies of climatic changes and global carbon cycle ("carbon sink/sequestration—see Gingrich et al. 2007), to studies of biodiversity and its changes (Haberl et al. 2004). Data and findings resulting from land use research help to explore the "ecological footprint" (Lustigová and Kušková 2006), "socio-economical metabolism" (Krausmann et al. 2003; Fischer-Kowalski and Haberl 2007; Kušková et al. 2008; Grešlová-Kušková 2013), or "ecosystematic services" (Lorencová et al. 2013). Land-change science can also contribute to geobotanical research (Vojta 2007). There are strong links between research of land use changes on one side and environmental history, historical geography (Jeleček 1994, 2007; Worster 1979, 1986, 1990; McNeill 2001; McNeill and Winiwarter 2004) on the other side: these subjects have common interests in nature–society interactions and their driving forces. Growing importance of the above-mentioned scientific fields are reflected in the existence of the European Society for Environmental History (ESEH) founded in 1999 (Jeleček et al. 2003; Jeleček 1994).

The importance of land use research is underlined by a number of international research groups and panels. To name a few: IGU Commission on Land Use and Land Cover Changes that originated as IGU study group as early as 1997; Land Use and Land Cover Change Project, part of the International Geosphere-Biosphere Programme (IGBP) and International Human Dimension Programme (IHDP), followed by series of projects Earth System Science Partnership (ESS-P); Global Land Project (GLP), originated in 2001.

Practical applications of land use research can be found in two fields—both are related to "land management and policy" (Aspinall 2008, p. 3). This is explained in the world's first Encyclopedia of Land-Use and Land-Cover Change (Geist 2006).

First, there are a number of aspects related to "land use planning and environmental management and care" (Aspinall 2008, p. 11). This includes spatial and metropolitan planning, landscape planning, and prevention of natural hazards (for instance flood prevention which is especially important in Czechia—see Váňová and Langhammer 2011). Important part of landscape planning is also planning of environmental networks. In Czechia these are called "Spatial Systems of Environmental Stability" (ÚSES, see Buček and Lacina 1993) and form a network of environmentally important habitats and wildlife corridors. Special attention should be devoted to urban planning, too, including development of brownfields (Ilík and Ouředníček 2007) and greenbelts and greenways planning (Fábos 1985; Fábos and Ahern 1996). Spatial modelling and prediction of urban development are related to this as well (Koomen et al. 2007; Kolejka 1991).

Second, results of land use research find a number of practical applications in decision-making processes related to landscape and soil management. Aspinall (2008, pp. 10–11) argues the necessity "to explore impacts and consequences of particular policies (and alternatives) and to contribute to the development of strategies to adapt to and manage change and its impacts". In Czechia and in Europe as well a good deal of land use research focuses on agricultural policies—subsidies aimed at landscape maintenance, reforestation, increase of grasslands, and aid to farmers in less favoured areas (LFA) (Štych and Stránský 2005; Kabrda and Jančák 2007; Doucha 2001; Doucha and Divila 2005). Conditions for biomass production as renewable energy source are also being assessed (Haberl et al. 2003; Campbell et al. 2008). Also, various environmental policies use results of land use research—which include "traditional" conservation issues (Natura 2000, different types of other protected areas), too.

Land use research, however, should not be understood just as a data source in this context. The greatest contribution is the analysis and explanation of spatial patterns, factors, and relations with respect to practical use of given area. Land use research helps to reveal trends that change over time and the role of different driving forces. Thus, it can formulate realistic prognoses of future land use.

2.3 History of Land Use in the World

A number of noted scholars have studied land use over the past two centuries (Geist 2006). In the following text four scientists who contributed most to land use research are mentioned. They either created the base of modern land use mapping (Stamp, Kostrowicki) or analysed regularities of spatial patterns reflecting the use of land by humans and formulated theories that are still valid, with interdisciplinary consequences (von Thünen, Marx).

Von Thünen was a German economist and landowner, pioneer of spatial economy in economic geography. In 1826 he published "The Isolated State" (von Thünen 1990), book that included basic analysis of factors influencing spatial patterns of agricultural production (Grigg 1995). Von Thünen was influenced by classical liberal economists (including Smith 2001 and Ricardo 1973) and based his theory on simplified model of an ideal "isolated state". He used two key values: land rent (understood as profit from land seen as a factor and mean of production) and intensity of production (labour force needed per one hectare). Von Thünen argues that it is the geographical location of any piece of land that influences most the structure and intensity of agricultural production (and consequently also the local land use). In von Thünen's terms geographical location means distance from the market and transport costs.

In fact von Thünen formulated two theories—intensity theory and that of crop zones. The intensity theory which describes differences of production intensity of a given crop in an "isolated state" is, though less known, more general and of higher value nowadays. It stipulates that going from the "centre" towards "periphery", land rent decreases due to rising transport costs. Consequently, the production intensity of any given crop decreases, too. What really counts is the "limiting productivity" and dwindling profits (Grigg 1995)—farmers distant from the "centre" must pay higher transport costs and these are balanced by lower inputs (lower intensity).

Von Thünen's theory of crop zones is well known but it much reflects the conditions of early nineteenth century. In that time carts pulled by animals were used as the only means of transport of agricultural products—it was slow, costly, and limited to short distances. According to the theory of crop zones, the land rent which decreases from centre towards periphery influences also the structure of crops grown and animals bred. This fact results in a sort of concentric "rings" of agricultural activity, i.e. areas of different land use (see Fig. 2.1). The sequence of rings is linked to the intensity theory, especially when it comes to rings 3, 4, and 5:

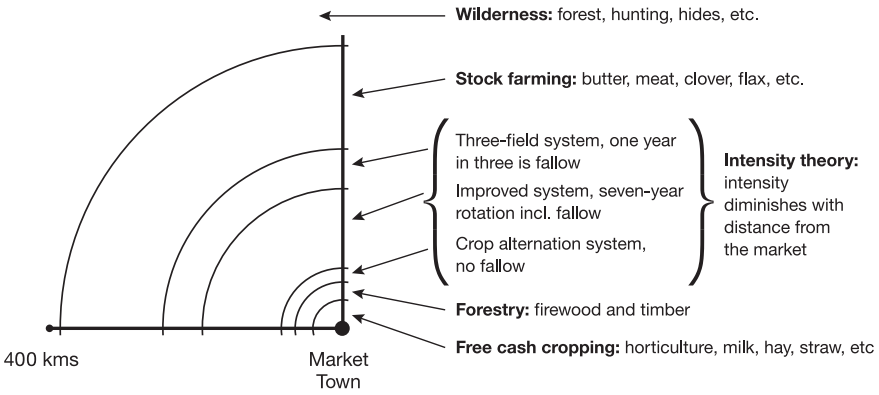

Fig. 2.1 Von Thünen's theory of crop zones—concentric rings of different land use. *Source* adapted according to Grigg (1995, p. 116)

the portions of fallow land rises, intensity diminishes (see Fig. 2.1). Von Thünen's rings also reflect the durability of products (milk, vegetables vs. cheese, wine) and value per kilo (hay, wood vs. wool, tobacco).

A critical approach should be adopted for von Thünen's theories nowadays, especially for crop zones. These theories reflect conditions in the early nineteenth century and show a number of imperfections typical for classical economic theories. However, it was one of the first attempts to explain spatial distribution of agriculture and von Thünen's ideas were applied also outside agricultural geography (see Peet 1970). The intensity theory is partly valid also at the present time. Geographical location, especially with respect to transportation network, does influence land use—as it will be shown later in this publication.

A number of economists studied land rent in the course of the nineteenth and twentieth centuries. It reflected the transition towards free market capitalism, towards "new modes of production" and "new ways of life/human existence". Marx coined the term "differential land rent" (DLR in further text) in his key work "Capital", namely in vol. III/2, Sect. 6 (Marx 1967). Jeleček studied the Marxist approach towards DLR with respect to land use changes in Czechia (Jeleček 1985, 2002; ibid, in Geist 2006).

Unlike Marx, von Thünen defines the differential rent "…as an index of natural scarcity whether of locations or differentially fertile lands, while in the Marxist account it is an expression of the monopoly power of capital as a whole." (Jeleček in Geist 2006, II, p. 356).

The term "differential land rent" equals "surplus profit". The effects of such a rent change over time as a result of economic, technological, and population changes and remain one of the key factors of changing land use patterns.

Marx argues that DLR is influenced by different natural and geographical conditions for agriculture; the rent has a profound spatial effect. Marx distinguishes between two types of differential land rent. DLR I has two parts and it is related to pieces of land that differs in two aspects: (a) in geographical position (distance from market), (b) in natural fertility of land. The geographical position allows producers to move from quality soils to less fertile ones (this was also agreed by Ricardo 1973) or vice versa: from low quality soil (in better location though) towards fertile soil in less favoured position. Thus, agricultural productivity can be improved in all cases.

"DLR II is viewed as a factor of agriculture intensification. It represents an extra profit that is created by unequal investments of capital into plots of land with the same natural fertility and/or geographical position DLR II of their soils. DLR II is related to more effective capital (e.g. by use of fertilizers, mechanization, breeding, etc.). Its affects fertile land as well as land in less fertile regions" (comp. Jeleček in Geist 2006). DLR II much enhanced the importance of geographical location as such. The railway boom at the end of the nineteenth century brought a number of local railways that secured the links between sugar beet production and sugar factories (in fertile regions) and among potato production, distilleries, and starch factories (in less fertile regions). DLR II formed the mutual links between agricultural production and the food industry. It became crucially important at

the end of the nineteenth century when more advanced technologies started to be used in agriculture after the long agrarian crisis in the 1880s (Jeleček 1985; ibid in Geist 2006, II, pp. 588–590).

DLR II is inevitably linked to use of more advanced agricultural technologies and to growing cooperation between farmers on one side and various industries (machinery, chemical industry) on the other side. In such a way, agricultural–industrial complex gradually came into existence. New, often expensive technologies included use of fertilizers, modern machines, and energy sources as well as drainage, irrigation, terraced fields, etc.

In free market economy the effects of ground (land) rent are beyond dispute. It is very different, however, in centrally-planned economies (under Communism—compare for instance the so-called "differential payments". Land use changes that have occurred since 1990 in Czechia, both at microregional and national levels, verified this hypothesis—a fact that we see as an important result of this research. The combined size of disused land has increased to 350,000 hectares between 1990 and 2005, which equals to 12 % of all arable land. DLR I and DLR II have been much influenced by the transformation of Czech agriculture since 1990, by increasing capital inputs and by fierce competition on the agricultural markets where farmers had to cope with imports of more subsidized products from EU countries (meat, milk, fruits) and other regions (Argentine beef).

The British geographer Stamp is considered the founder of modern land use research; he also established this term. Stamp organized "Land Utilisation Survey", i.e. land use mapping of British Isles. It was carried out in the 1930s with the idea of "a field-to-field survey of the whole country, covering every acre and recording its use" (Stamp 1948). Thousands of volunteers, first of all school children, did the mapping parish by parish. Scale of the maps was 1:10,560 and six basic land use types were distinguished: bog and heath, grassland, forests, arable land, gardens, and "non productive land" which included also built-up land, i.e. plots that were not subject to agricultural tax.

During World War II, these maps were used to identify soil suitable for food production. With a certain degree of exaggeration one can say that Stamp's Land Utilisation Survey helped to save Britain from famine. In the post-war period these maps were used for greenbelts planning—A vision of Britain through time (2014) and now are available online (http://visionofbritain.org.uk). Stamp later became adviser to the former British Ministry of Agriculture, received the Order of the British Empire, and held important posts within the International Geographical Union (IGU).

When compared with cadastral maps that had been compiled a hundred years earlier on the territory of Austro-Hungarian Empire (see Chap. 5), the British maps were less detailed, less accurate, and had a simpler structure. In spite of this Stamp's contribution is indisputable. In Great Britain, Land Utilisation Survey was the first systematic survey since the eleventh century when Domesday Book (survey of villages and domains containing individual houses and farms including holdings and values to determine taxes) had come to existence in England in 1086. On the world scale, Stamp was the first

geographer ever who focused on systematic mapping and scientific assessment of land use. Consequently, he is widely considered the founder of land use research.

Polish geographer Kostrowicki (Jerzy) successfully developed Stamp's ideas. Kostrowicki focused on typology and classification of agricultural systems in the second half of the twentieth century and published a number of scientific books containing detailed surveys and analyses of agricultural systems in the world. He also held high posts within the IGU.

Kostrowicki led a number of projects that carried out land use mapping in Poland and other Central European Countries between the 1950s and 1970s (Kostrowicki 1965)—for this reason he is especially important for Czech geography. It was mostly very detailed mapping in small areas (municipalities), typically at scales 1:10,000–1:25,000; the main focus was on agricultural land. Kostrowicki's maps do not show the use of land in one moment (year), but rather identify long-term land use of large homogeneous units. The map's symbology is a very detailed one showing among other things ownership, land fragmentation, crop rotation and—most important—also dominant crops (structured by several criteria) and its share on the arable land (Kostrowicki 1965). Kostrowicki's maps and analyses show in detail spatial patterns of agricultural production in the landscape and are unique at the world scale.

2.4 Current Approaches in Land Use Research in the World

Among the most frequent questions land use researchers presently ask are: What are the driving forces behind land use changes? What is more important, natural structure or human factors? Are natural conditions more important than the social ones or vice versa? What are the crucial factors of natural and social driving forces?

Seeking answers to the above-mentioned questions brings a number of benefits for land use research. It allows to formulate research schemes and relevant hypotheses and to choose an appropriate method which consequently helps to analyse, interpret, and explain research results. Most researchers, however, have not tried hard so far to find satisfactory answers. There is nothing like a widely shared paradigm in land use research and the same applies to major research methods—not to speak about the essence of examined phenomena.

Most researchers just state that land use changes are the result of nature–society interaction. The equation "land use = nature + society" is sometimes explained in a formalized version as a diagram containing boxes (sub-systems) and arrows (links). Such schemes can be helpful, but remain too vague and broad; Lambin argues that in the past it "provided theoretical guidance but were not theories per se. Rather, they tended to have a more ad hoc quality which recognized the

underlying complexity of the determinants of land cover/use change" (Lambin et al. 2006, p. 5). The same author (Lambin et al. 2006, p. 7) calls for a more elaborated, detailed, and complex theory of land use. Most scholars agree on that such a theory has not yet appeared. Land use studies have not been fully integrated into one complex system also due to the fact that land use is studied by scholars from at least three different broad scientific fields: natural, spatial, and social sciences. It is a highly interdisciplinary issue.

This publication does not aim at providing a full list of existing theories, concepts, and approaches that are used in land use research; more information on this can be found in comprehensive Encyclopedia of Land-Use and Land-Cover Change (Geist 2006), published in two volumes. Concepts we see as crucial plus those that influenced most our research will be discussed in further text. It should not be confused with real "theories"—we rather explain concepts and approaches that also may include theoretical ideas of land use changes as well as methodological frameworks suggesting appropriate research methods.

The DPSIR model belongs to such concepts—see EEA (1999), Feranec et al. (2001) and Bičík and Kupková (2007). It is a formalized analysis that allows to explain land use changes as part of a whole network of relations between humans and the environment (see Fig. 2.2). The DPSIR model is sometimes understood as a general logical framework that sets directions and modality of our analyses. It can also be viewed as a mathematical model allowing quantification of variables.

The DPSIR model works with "drivers" which means social and economical development (for instance high world prices of ethanol fuel caused by attempts to reduce the amount of energy generated from non-renewable resources). Drivers induce "pressures" on the environment (for example higher demand for sugar cane in Brazil). Pressures cause changes in the "state", i.e. in the existing environment, landscape, and land use structure (deforestation in the Amazon Basin). Land use changes have "impacts" on the society (higher crime rate, social differences, migration…) and especially on nature and habitats. These impacts can be both local (erosion, floods, biodiversity reduction, habitat loss) and global (climatic change, carbon cycle). Impacts lead to human "responses" (search for alternative energy sources, higher forest protection, emission control, etc.). Responses are in

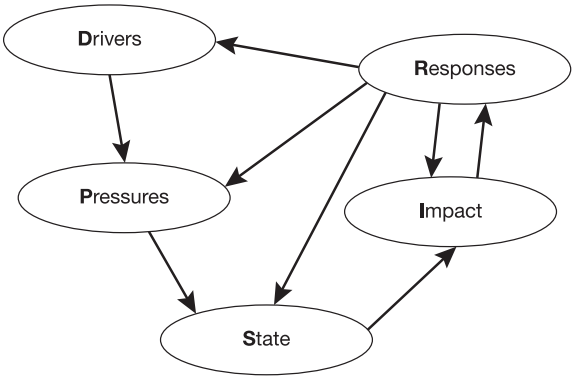

Fig. 2.2 DPSIR concept—scheme. *Source* Adopted by EEA (1999); explanations in text

fact a sort of a feedback—attempts to reduce negative aspects of human behaviour. Responses can be aimed at all preceding parts of the scheme, yet mostly at drivers.

EEA (1999, p. 7) argues that it makes sense "to focus on the *links* between DPSIR elements", as these links have effects on functioning of the model. As an example, relations between "drivers" and "pressures" are influenced by the technology used. Relations between "state" and "impact" depend on threshold values and absorbing capacity. Quantification of DPSIR model (in other words, definition of valuables and relations among them) can help to predict future changes according to the scenarios defined—it allows to test the behaviour of the model when selected parameters are changed. Though DPSIR shows a high practical potential, it should be considered that it is a *mathematical* model: as such, it reflects only variables that can be quantified, and relations that are known.

In our opinion, the "multi-level explanatory scheme" is the most complex concept used in land use research so far. It was formulated by Scottish geographer Mather (2002). The author attempted to generalize the causes of land use changes and to set the main concepts of land use research. Mather defines three key groups of factors that influence land use changes and regional patterns (see Fig. 2.3).

First, there are "proximate" factors, i.e. indicators/facts that can be quantified and that have a direct relation (statistical correlation) to land use—natural conditions or population changes, for example. Most researchers focus just on these factors. This is a fact criticized by Mather; he argues that identifying of these proximate factors is insufficient for explanation of land use changes. Mather (2002), p. 29 stipulates that proximate factors are "*contingent* and have *relative*, rather than *absolute*, effect". Directions and intensity of proximate factors change over time and depend on "intermediate" factors. These are economic and technological tools used by humans to alter the environment; Mather (2002, p. 29) calls

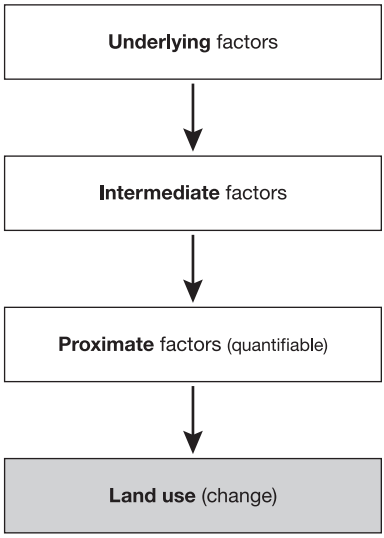

Fig. 2.3 Multi-level explanatory scheme according to Mather. *Source* Mather (2002); explanations in text

it "mode of production". Intermediate factors, however, are not fully stable either; their changes, according to Mather, are caused by changing "underlying" factors, i.e. by political, institutional, and cultural conditions.

Proximate factors are quantifiable and related to the smallest territorial units examined (plots, municipalities). On the contrary, intermediate and underlying factors have rather qualitative characters and are related to large areas (national, global levels). Mather underlines the importance of culture in broad sense, i.e. including the system of rules, habits, beliefs, ideology, ethic rules, interest in environmental issues, etc. Such a view is antagonistic to Marxist approaches that favour materialism and advocate the crucial importance of economic base.

According to Mather, any prediction of future land use changes must be preceded by a sound assessment of intermediate and underlying factors—a very difficult task. Prediction that would be based just on proximate factors is too simple and incomplete.

Mather used the multi-level explanatory scheme while examining changes within forested areas in Western Europe, especially in France. He is one of the key authors of the "forest transition" concept (Mather and Needle 1998). Mather's idea was that the forest cover in developed countries has followed the "U" curve—in a certain time, long-term decrease of forests was replaced by increase.

Decrease of forest cover (in terms of area) was typical for the Middle Ages and early modern history. It was caused by growing population (proximate factor) and rather primitive agricultural practices (intermediate factor) which required more and more agricultural land and led to deforestation. The whole process happened in non-democratic systems (underlying factor). This trend, however, changed in the nineteenth century and forests began to expand, though at the same time population was still growing. The influence of population growth as a proximate factor reversed due to changing nature of intermediate factors—more advanced agricultural practices (which made possible to cultivate less land) and decreasing demand for wood which was gradually replaced by other materials (iron, concrete, fossil fuels). Also, the underlying factors changed: Age of Enlightenment, democratization, conservation laws. As an example, forest management rules in Bohemia were in effect as early as in the mid-eighteenth century, and in 1852 a modern Forest. Act No. 252 was passed.

The forest transition concept brings a number of challenges. Is it a global model? According to Mather (2002), probably so—the main driver is progress, though the exact form and timing depends on local cultural and political contexts and it can be stimulated by crises (erosion, floods, devastation). And let us go further: if forest transition really was global as a product of the Modern Age, how is the model going to look like in the Post-Modern Era? While seeking answers to the above questions, the multi-level explanatory scheme seems to be an appropriate base.

Mather's approach to land use changes was later elaborated by other scholars like Lambin, Geist, and Aspinall. These researchers accept the idea of proximate and underlying factors though definitions differ slightly from that of Mather (Aspinall 2008). Lambin and Geist (2007) argue that factors influencing land use

changes should be sorted by time. On the one hand there are long-term factors that have gradual effects and determine natural qualities of respective regions. These include biophysical factors (climate, topography, biota) and social and economic factors (economic conditions, political system). On the other hand there are also factors that function as "trigger events". In Mather's concept these are crises that influence the timing of crucial processes. Some trigger events are of biophysical nature (droughts, tropical cyclones), other have socio-economic roots (wars, economic crises).

Lambin and Geist underline the importance of "agents". These "constantly make trade-offs between different land-use opportunities and the constraints imposed by a variety of external factors". Consequently, in order to identify causes of land use changes it is crucial to understand "how people make land-use decisions (decision-making processes) and how specific environmental and social factors interact to influence these decisions (decision-making context)". In this sense the activity of "agents" equals to local proximate factors; on the other hand, underlying factors reflect more the broader context and structure. This approach brings land use research close to the "structuration theory" proposed by Giddens (1984) and "method in social science" by Sayer (1984).

The ideas of Giddens and Sayer were elaborated by Lambin and Geist (2007), who argue that "despite the diversity of causes of land-use change, there are some generalizable patterns". Though mechanisms and factors driving land use changes show an extreme complexity, there are a few processes that keep repeating. Understanding these processes "may confer some predictive power by analogy with similar pathways in comparable regional and historical contexts" (ibid.).

The above-mentioned examples suggest that though no kind of a compact theory of land use changes exists so far, some basic ideas are gradually being generally accepted. Here are a few examples of such widely shared concepts: (a) land use patterns result from long-term interactions between nature and society, with important feedbacks; (b) landscape has a sort of a "memory", current land use is influenced by present and past processes; (c) "mode of production", i.e. economic and technological driving forces are important (Bürgi et al. 2004); (d) factors influencing land use patterns can be divided into two groups: proximate factors (on local level) and underlying factors (at national and global levels). The fact that Mather, Lambin, Geist, Aspinall, and other scholars reached a consensus of opinion on basic issues forms a sound basis for a potential "big" future theory of land use (Aspinall 2008). Publications of the above mentioned researchers were an important source of inspiration also for the findings presented in this book.

2.5 Land Use Research in Czechia: Past and Present

The first research works dealing with land use and changes of landscape structure on the Czech territory appeared after World War II. Regarding theory and methods, Czech authors elaborated the ideas of Stamp (1948) and especially that of

Kostrowicki (1965). The first Czech studies focused on land use were conducted by Häufler (1955, 1960) and Brinke (1975). The Häufler's publication dealing with land use of mountainous areas in Czechoslovakia was an important one as it constituted the first geographical analyses of Czech borderland after the post-war transfer of Czechoslovak Germans to Germany and Austria. Historical approach to land use was adopted by Pokorný (1959).

Czech researchers have been examining land use patterns in middle-sized regions since the 1970s. The concept of detailed land use analysis (by cadastral units) was created by Bičík and later tested in North West Bohemia (Bičík 1998; Bičík and Štěpánek 1994). Analysis of land use changes in the second part of the nineteenth century in ca. 200 so-called judicial districts was carried out by Jeleček, with respect to the final phase of "agricultural revolution" (Jeleček 1985, 1995, 2002). Vondruška (1984) studied the influence of natural conditions on agriculture and also land use patterns in agricultural landscape in the early nineteenth century. Černý (1988) devoted his attention to why mediaeval villages ceased to exist in less favoured areas of Central Moravia.

In the world context, the maps (scales 1:1,000,000–1:5,000,000) that became part of the World Atlas of Agriculture (1969) were very important for land use studies. Later, similar maps became part of national atlases (scales 1:400,000–1:1,000,000). In accordance with this trend also the Czechoslovak National Atlas (Atlas ČSSR 1966) included land use map of Czechoslovakia (scale 1:1,000,000), which was also published separately in 1967 (scale 1:500,000). These maps brought at least a general picture of land use patterns of that time. The progress of remote sensing in the 1980s opened new horizons in land use studies; digital maps of large areas became commonly used and all this brought fundamentally new qualities and also new challenges. Land use maps became part of Czechoslovak (Czech) national atlases also under new political conditions after 1989. The Atlas of the Environment and Health of the Population of the ČSFR (1992) and especially the Landscape Atlas of the Czech Republic (Hrnčiarová et al. 2009) are important examples; the authors of this book contributed to the latter. The maps of land use/cover change, carried out by Bičík and his team and forming part of the Academic Atlas of Czech History (Semotanová et al. 2014), are the latest examples.

Basic research of land use fully developed in Czechoslovakia (Czech Republic) only after 1989. There are two main research directions at the moment (Kolejka 2002): analyses of small areas, and the so-called "Prague school".

Analyses of small regions (consisting of one or more cadastral areas) focus on the role of local factors on land use changes (Kolejka 2002, p. 150). Land use types are usually related to natural landscape types. Interdisciplinary approach is essential as is the accent on historical geography and environmental history. Detailed maps related to different years are mostly used, as well as the outcomes of field land use research. This combination allows comparison of land use changes over time which is necessary for future predictions.

The utilization of geographic information systems (GIS) since the 1990s has enabled old maps to be more widely excerpted. Digitized historical maps of old

manors, lakes, villages, and pieces of landscape became an important source of knowledge as regards historical land use. Now it is possible to trace landscape changes over the past three centuries, i.e. including the pre-industrial period. Such old maps (ca. between the early eighteenth and mid-nineteenth century), however, are often rather simple and not fully accurate. This also applies to the maps (scale 1:28,800) that resulted from the 1st Military Survey carried out under Emperor Joseph II between 1785 and 1789 (for more information see Chap. 5). The 2nd Military Survey, started under Emperor Francis II was much more accurate and is compatible with modern maps. The 2nd Military Survey had begun in Lower Austria in 1817 and was finalized in Tyrol in 1861. Maps of the Second Military Survey were derived from the so-called "stable cadastre", i.e. from very precise map of scale 1:2,880 that were compiled in Bohemia (1826–1843) and Moravia and Silesia (1824–1836). (For the location of historical lands of Czechia see Fig. 4.1). These maps constitute a priceless source of information for researchers studying long-term land use changes and are directly linked to more recent cadastral maps up to present—only the scale (now 1:2,000) has changed since (Mašek 1948; Kain and Baigent 1992; Bumba 2007; Jeleček 2006).

In land use research, maps from the 1st Military Survey were first used in the North Bohemian Coal Basin by Brůna (in Beneš et al. 1993). Copies of all maps from the first and second Military Survey, covering the whole Czech territory, were bought from Austria by the Ministry of Environment of the Czech Republic in 2001. Currently these copies are deposited in the Laboratory of Geoinformatics, University J.E. Purkyně, Ústí nad Labem—1. a 2. vojenské mapování (2014), and can be accessed online (http://oldmaps.geolab.cz/). The Laboratory has published guidelines for use of these maps in land use and landscape research (Uhlířová 2002; Brůna et al. 2003).

This publication presents research results of the so-called Prague school, group of researchers headed by Bičík at the Faculty of Science, Charles University, Prague. The main focus has always been on long-term land use changes in Czechia, often including statistical methods. The research team was established in the mid-1990s; apart from Bičík, also Jeleček, Štěpánek, and Lipský were among the founding members. Over time, more and more young researchers became team members and the use of GIS technologies grew. Social geographers, however, are still the key team members—consequently, the research keeps focusing on social driving forces of land use changes. Among collaborators there are physical geographers, environmentalists, and cartographers, too, which makes the research a truly interdisciplinary one.

Bičík with his team focuses mostly on the changing nature of Czech landscape in the course of the past two centuries, i.e. in the age of modernization and technological advance. Crucial is the search for "driving forces" of land use changes, including social, economic, political, institutional, cultural, and other factors (Bürgi et al. 2004). Rather than just detailed analyses of individual components (natural, social), complex, systematic approaches towards human–nature interaction (Hampl 2000) are preferred.

Bičík and his research team created "Database of long-term land use changes in Czechia (1845–2010)" which is based on statistical data concerning land use

structure in all 13,000 cadastral areas in Czechia. Thus, the extraordinary historical records of land ownership and use of plots that have been founded in Cisleithania already in 1817 (Jeleček 2006; see Chap. 5) are being utilized and complemented. In Transleithania (eastern part of Austro-Hungarian Monarchy) all mapping was carried out much later. The Slovenian research team, headed by Gabrovec, uses the same source of data for land use research in Slovenia (Gabrovec and Kladnik 1997; Gabrovec et al. 2001).

Bičík and his research team have published a number of scientific publications since the early 1990s. These mostly focus on analyses and interpretation of the above-mentioned data, at the national and regional levels (regions, protected areas, metropolitan regions, etc.). Let us cite at least a few of the many articles and chapters: Bičík (1995, 1998); Bičík and Jeleček (2005, 2009); Bičík and Kupková (2007); Bičík et al. (2001, 2002, 2010a); Jeleček (1995, 2002); Kabrda (2004, 2008); Kupková (2001); Kupková et al. (2013); Mareš and Štych (2005); Mareš et al. (2013). Of special importance is publication summarizing the existing research results (Bičík et al. 2010b). The research team also contributes to the series of atlases "Land Use/Cover Changes in Selected Regions in the World", published by the IGU-LUCC Commission: Volume I (Himiyama et al. 2001), Volume V (Bičík et al. 2010c). Two of these atlases are dedicated solely to Czechia (Volume VII, IX in Bičík et al. 2012, 2014).

The data used, however, lack territorial details and the explanatory value diminishes (see Chap. 5 and Sect. 6.7). To overcome this problem and to verify and complement research results, Bičík and his team also carry out detailed analyses of small areas (cadastral units). In this way, maps from different years and compared with each other and with satellite images; field mapping are also used (Kupková 2001; Mareš and Štych 2005; Bičík et al. 2012). In most cases these detailed analyses compare maps from early nineteenth century (cadastral maps), mid-twentieth century (ortophoto), and present (field mapping). Such analyses, however, are time-consuming and cover just small areas.

Recently, remote sensing data became available. The European Land Cover Database CORINE (http://www.eea.europa.eu/data-and-maps, see Chap. 5) is an ideal data source—CORINE Land cover (2014). It was created by interpretation of Landsat images; at the moment, data from 1990, 2000, and 2006 are available. CORINE data are being used by Slovak research team headed by J. Feranec (Feranec et al. 2001, 2007). CORINE data cover whole Europe, but the grid is not much detailed (square equals 5 or 25 ha) and the land cover classification is complicated with a number of heterogeneous classes. Moreover, CORINE data (that show land cover) are not easily comparable with cadastral data (that show land use; see Sect. 2.1), and are available for a rather short period of time—last two or three decades.

As a result, land use research in Czechia faces an important challenge: in the future it seems necessary to elaborate a new methodological concept that would enable to combine at least three different data sources, taking into account different size of regions and different years. These data sources include statistical land use data from cadastral sources (since 1845), detailed land use/cover maps from

small regions, and remote sensing data (ideally Europe-wide CORINE data plus data collected by LANDSAT, Spot, and other satellites).

References

A vision of Britain through time (2014) University of Portsmouth. Available http://www.visionofbritain.org.uk. Accessed 20 March 2014

Aspinall RJ (2008) Basic and applied land use science. In: Aspinall RJ, Hill MJ (eds) Land use change: science, policy and management. CRC Press, Boca Raton, pp 3–15

Aspinall RJ, Hill MJ (eds) (2008) Land use change: science, policy and management. CRC Press, Boca Raton

Atlas ČSSR (1966) Atlas Československé socialistické republiky. Československá akademie věd, Prague

Atlas of the Environment and Health of the Population of the ČSFR (1992) Atlas životního prostředí a zdraví obyvatelstva ČSFR. Federální výbor pro životní prostředí, Prague

Beneš J, Brůna V, Křivánek R (1993) The changing landscape of North-West Bohemia during the last two centuries. Památky archeologické 84:142–149

Bičík I (1995) Possibilities of long-term human-nature interaction analysis: the case of land use changes in the Czech Republic. In: Simmons IG, Mannion AM (eds) The changing nature of the people-environment relationship: evidence from a variety of archives. Charles University in Prague, Prague, pp 47–60

Bičík I (1998) Land use in the Czech Republic 1845–1948–1990: methodology, interpretation, contexts. AUC Geographica 32(Supplementum):247–255

Bičík I, Jeleček L (2005) Political events factoring into land-use changes in Czechia in the 20th century. In: Milanova EV et al (eds) Understanding land-use and land-cover change in global and regional context. Science Publishers, Enfield, pp 165–186

Bičík I, Jeleček L (2009) Land use and landscape changes in Czechia during the period of transition 1990–2007. Geografie 114(4):263–281

Bičík I, Kupková L (2007) Land use development in the Czech Republic and possibilities of generalization and modeling. In: Dostál P, Langhammer J (eds) Modeling natural environment and society. P3 K, Prague, pp 179–204

Bičík I, Štěpánek V (1994) Long-term and current tendencies in land-use: case study of the Prague's environs and the Czech Sudetenland. AUC Geographica 29(1):47–66

Bičík I, Jeleček L, Štěpánek V (2001) Land-use changes and their social driving forces in Czechia in the 19th and 20th centuries. Land Use Policy 18(1):65–73

Bičík I, Chromý P, Jeleček L et al (2002) Comparison of land use changes in and outside biosphere reserves in Czechia. In: Himiyama Y et al (eds) Land use changes in comparative perspective, Chapter 19. Oxford and IBH Publishing, New Delhi, pp 249–258

Bičík I, Kabrda J, Najman J (2010a) Land-use changes along the iron curtain in Czechia. In: Anděl J et al (eds) Landscape modelling: geographical space, transformation and future scenarios. Urban and landscape perspectives series, vol 8. Springer, Dordrecht, pp 71–85

Bičík I et al (2010b) Vývoj využití ploch v Česku. ČGS-Edice Geographica, Prague

Bičík I, Himiyama Y, Feranec J (eds) (2010c) Land use/cover changes in selected regions in the world—Volume V. IGU Commission on LUCC, Charles University in Prague, Prague

Bičík I, Himiyama Y, Feranec J et al (eds) (2012) Land use/cover changes in selected regions in the world—VII. Charles University in Prague, IGU Commission on LUCC, Prague

Bičík I, Himiyama Y, Feranec J et al (eds) (2014) Land use/cover changes in selected regions in the world—IX. IGU Commission on LUCC, Charles University in Prague, Prague

Brinke J (1975) Vývoj a ochrana zemědělského půdního fondu v ČSR. Práce i studia Instytutu Geografii 16:53–62

Brůna V, Buchta I, Uhlířová L (2003) Interpretace prvků mapy prvního a druhého vojenského mapování. Historická geografie 32:93–114
Buček A, Lacina J (1993) Územní systémy ekologické stability. Veronica, Brno
Bumba J (2007) České katastry od 11. do 21. století. Grada, Prague
Bürgi M, Hersperger AM, Schneeberger N (2004) Driving forces of landscape change—current and new directions. Landscape Ecol 19(8):857–868
Campbell JE, Lobell DB, Genova RC et al (2008) The global potential of bioenergy on abandoned agriculture lands. Environ Sci Technol 42(15):5791–5794
Černý E (1988) Results of historical and geographical research in the deserted medieval villages and their field patterns in the Drahanská uplands of Czechoslovakia. Historická geografie27:173–197
CORINE Land cover (2014) European Environment Agency. Available http://www.eea.europa.eu/data-and-maps. Accessed 27 Jan 2014
Doucha T (2001) Czech pre-accession agricultural policy and utilisation of agricultural land. Agric Econ 47(7):281–284
Doucha T, Divila E (2005) Possible impacts of the Czech agricultural policy after the EU accession on the land market and land usage. Agric Econ 51(5):185–193
EEA (1999) Environmental indicators: Typology and overview. EEA Technical report 25, Copenhagen
Fábos JG (1985) Land-use planning: from global to local challenge. Chapman & Hall, New York
Fábos JG, Ahern J (eds) (1996) Greenways: the beginning of an international movement. Elsevier, New York
FAO (1998) Terminology for integrated resources planning and management. Available http://www.fao.org/sd/eidirect/land/EPre0081.htm. Accessed 17 Feb 2014
FAO (2000) Land cover classification system (LCCS). Available http://www.fao.org/docrep/003/x0596e/x0596e01e.htm. Accessed 18 Feb 2014
Feranec J et al (2001) Landscape change detection, analysis and assessment in the Phare countries—the Czech Republic, Hungary, Romania and the Slovak Republic. In: Himiyama Y et al (eds) Land use/cover changes in selected regions in the world—I. IGU Commission on LUCC, Asahikawa, pp 53–60
Feranec J, Hazeu G, Christensen S et al (2007) Corine land cover change detection in Europe (case studies of the Netherlands and Slovakia). Land Use Policy 24(1):234–247
Fischer-Kowalski M, Haberl H (eds) (2007) Socioecological transitions and global change: trajectories of social metabolism and land use. Edward Elgar Publishing, Cheltenham
Gabrovec M, Kladnik D (1997) Some new aspects of land use in Slovenia. Geografski sbornik –. Acta Geogr 37:7–64
Gabrovec M, Petek F, Kladnik D (2001) Land use changes in the 20th century in Slovenia. In: Himiyama Y et al (eds) Land use/cover changes in selected regions in the world—I. IGU Commission on LUCC, Asahikawa, pp 41–52
Geist H (ed) (2006) Our earth's changing land: an encyclopedia of land-use and land-cover change, vol 1: A—K, vol 2: L—Z. Greenwood Press, Westport
Giddens A (1984) The constitution of society: outline of the theory of structuration. Polity Press, Cambridge
Gingrich S, Erb KH, Krausmann F et al (2007) Long-term dynamics of terrestrial carbon stocks in austria: a comprehensive assessment of the time period from 1830 to 2000. Reg Environ Change 7(1):37–47
Grešlová-Kušková P (2013) A case study of the Czech agriculture since 1918 in a socio-metabolic perspective—from land reform through nationalisation to privatisation. Land Use Policy 30(1):592–603
Grigg D (1995) An introduction to agricultural geography. Routledge, London
Haberl H, Erb KH, Krausmann F et al (2003) Land-use change and socio-economic metabolism in Austria—Part II.: land-use scenarios for 2020. Land Use Policy 20(1):21–39
Haberl H et al (2004) Human appropriation of net primary production and species diversity in agricultural landscapes. Agri Ecosyst Environ 102(2):213–218

Hampl M (2000) Reality, society and geographical/environmental organization: searching for an integrated order. Charles University in Prague, Prague
Haüfler V (1960) Evidence of the land use in Czechoslovakia. Sborník ČSZ 65(3):268–272
Häufler V (1955) Horské oblasti Československa a jejich využití. Academia, Prague
Himiyama Y, Mather A, Bičík I et al (eds) (2001) Land use/cover changes in selected regions in the world—I. IGU Commission on LUCC, Asahikawa
Hrnčiarová T, Mackovčin P, Zvara I (eds) (2009) Atlas krajiny České republiky (Landscape atlas of the Czech Republic). MŽP ČR, Prague
Ilík J, Ouředníček M (2007) Karlín and its changes in the context of post-socialist transformation of Prague. Geografie 112(3):292–314
Jeleček L (1985) Zemědělství a půdní fond v Čechách ve 2. polovině 19. století. Academia, Prague
Jeleček L (1994) Economic-political development and environmental changes in former Czechoslovakia 1948–1989. Geografie 99(2):79–92
Jeleček L (1995) Využití půdního fondu České republiky 1845–1995: hlavní trendy a širší souvislosti (The use of agricultural land in Czech Republic 1845–1995: key trends, broader contexts). Geografie 100(4):276–291
Jeleček L (2002) Historical development of society and LUCC in Czechia 1800–2000: major societal driving forces of land use changes. In: Bičík I et al (eds) Land use/land cover changes in the period of globalization. Proceedings of the IGU-LUCC international conference, Prague 2001. Charles University in Prague, Prague, p 44–57
Jeleček L (2006) Development of modern cadastre and cadastral mapping: cadastre as major information source of LUCC research in Czechia. Acta Geogr Univ Comenianae 49:37–51
Jeleček L (2007) Hlavní společenské hybné síly změn ve využití ploch Česka v 19. a 20. století: teorie a realita. In: Česká geografie v Evropském prostoru. In: Proceedings of the 21st conference of ČGS, České Budějovice 2006, Jihočeská univerzita, České Budějovice, p 1157–1164
Jeleček L, Chromý P, Janů J et al (eds) (2003) Dealing with Diversity. In: Proceedings of 2nd international conference of the ESEH, Prague 2003. Charles University in Prague, Prague
Kabrda J (2004) Influence of natural conditions on land use in the Vysočina region and its changes since the mid-19th century. AUC Geographica 39(2):15–38
Kabrda J (2008) The changing spatial structure of agricultural land use in Czechia since the mid-19th century. Geografický časopis 60(3):255–278
Kabrda J, Jančák V (2007) Vliv vybraných politických a institucionálních faktorů na české zemědělství a krajinu. Geografie 112(1):48–60
Kain RJP, Baigent E (1992) The cadastral map in the service of the state. a history of property mapping. University of Chicago Press, Chicago
Kolejka J (1991) Komplexní mapa využití ploch jižní Moravy. Zprávy GGÚ ČSAV 28(4):27–41
Kolejka J (2002) Czech experience with land use and land cover change research. In: Bičík I et al (eds) Land use/land cover changes in the period of globalization. Proceedings of the IGU-LUCC international conference, Prague 2001. Charles University in Prague, Prague, pp 144–152
Koomen E, Stillwell J, Bakema A et al (eds) (2007) Modelling land-use change: progress and applications. Springer, Dordrecht
Kostrowicki J (ed) (1965) Land utilization in East-Central Europe: case studies. Geographia Polonica 5. Wydawnictwa Geologiczne, Warszawa
Krausmann F (2001) Land use and industrial modernization: an empirical analysis of human influence on the functioning of ecosystems in Austria 1830–1995. Land Use Policy 18(1):17–26
Krausmann F, Haberl H, Schulz NB et al (2003) Land use change and socio-economic metabolism in Austria—Part I. : driving forces of land-use change 1950–1995. Land Use Policy 20(1):1–20
Kupková L (2001) Analýza vývoje české kulturní krajiny v období 1845–2000. Dissertation, Charles University in Prague

Kupková L, Bičík I, Najman J (2013) Land cover changes along the iron curtain 1990–2006. Geografie 118(2):95–115
Kušková P, Gingrich S, Krausmann F (2008) Long term changes in social metabolism and land use in Czechoslovakia, 1830–2000: an energy transition under changing political regimes. Ecol Econ 68(1–2):394–407
Lambin EF, Geist H (2007) Causes of land-use and land-cover change. In: Encyclopedia of earth. Available http://www.eoearth.org/view/article/150964/. Accessed 13 May 2014
Lambin EF, Geist H, Rindfus RR (2006) Introduction: local processes with global impacts. In: Lambin EF, Geist H (eds) Land-use and land-cover change: local processes and global impacts. Springer, Berlin, pp 1–8
Lipský Z (2000) Sledování změn v kulturní krajině. ÚAE LF ČZU, Kostelec nad Černými lesy
Lorencová E, Frélichová J, Nelson E et al (2013) Past and future impacts of land use and climate change on agricultural ecosystem services in the Czech Republic. Land Use Policy 33:183–194
LUCC Czechia Database: database of long-term land use changes in Czechia (1845–2010)
Lustigová L, Kušková P (2006) Ecological footprint in the organic farming system. Agri Econ (CZ) 52(11):503–509
Mareš P, Štych P (2005) Historical changes in Czech landscape in 1845–2000 and their natural and social driving forces studied at different spatial levels. In: Milanova EV et al (eds) Understanding land-use and land-cover change in global and regional context. Science Publishers, Enfield, pp 107–134
Mareš P, Rašín R, Pipan P (2013) Abandoned landscapes of former german settlement in the Czech Republic and in Slovenia. In: Rotherham ID (ed) Cultural severance and the environment. Springer Science + Business Media, Dordrecht, pp 289–309
Marx K (1967) Capital: a critique of political economy, vol. III/2, Section VI, chapters 37–47. International Publishers, New York
Mašek F (1948) Pozemkový katastr. Soupis, popis a geometrické zobrazení pozemků ČSR. Ministerstvo financí ČSR, Prague
Mather AS (2002) The reversal of land-use trends: the beginning of the reforestation of Europe. In: Bičík I et al (eds) Land use/land cover changes in the period of globalization. Proceedings of the IGU-LUCC international conference, Prague 2001. Charles University in Prague, Prague, p 23–30
Mather AS, Needle CL (1998) The forest transition: a theoretical basis. Area 30(2):117–124
McNeill JR (2001) Something new under the sun: an environmental history of the twentieth-century world. W.W. Norton & Company, New York
McNeill JR, Winiwarter V (2004) Breaking the Sod: Humankind, History and Soil. Science 304(11):1627–1629
Peet R (1970) Von Thünen theory and the dynamics of agricultural expansion. Explor Econ Hist 8(2):181–201
Pokorný O (1959) Obraz Čech v polovině 19. století v díle stabilního katastru. Sborník ČSAZ 64:222–231
Ricardo D (1973) The principles of political economy and taxation. Everyman's Library, London
Sayer RA (1984) Method in social science: a realist approach. Hutchinson, London
Semotanová E, Cajthaml J et al (2014) Academic atlas of Czech History. Academia, Prague
Smith A (2001) Pojednání o podstatě a původu bohatství národů (An inquiry into the nature and causes of the wealth of nations). Liberální institut, Prague
Stamp LD (1948) The land of Britain: its use and misuse. Longman, London
Štych P, Stránský R (2005) Dlouhodobé změny využití krajiny v méně příznivých oblastech pro zemědělství v kontextu vývoje zemědělské dotační politiky. In: Novotná M (ed) Problémy periferních oblastí. Charles University in Prague, Prague, pp 61–73
Thünen von JH (1990) Der isolierte Staat in Beziehung auf Landwirtschaft und National Ekonomie. Hrsg. und unter Benutzung unveröffentlicher Manuskripte kommentiert von H. Lehmann in Zusammenarbeit mit L. Werner. Academie-Verlag Berlin, Berlin

Uhlířová L (2002) GIS and old maps as a historical data source for landscape dynamics monitoring: case of model area Jáchymov—Bohemia. In: Bičík I et al (eds) Land use/land cover changes in the period of globalisation. Proceedings of the IGU-LUCC international conference, Prague 2001. Charles University in Prague, Prague, p 153–157

Váňová V, Langhammer J (2011) Modelling the impact of land cover changes on flood mitigation in the upper Lužnice basin. J Hydrol Hydromech 59(4):262–274

1. a 2. vojenské mapování, Laboratoř geoinformatiky Univerzity J.E. Purkyně v Ústí nad Labem. Available http://oldmaps.geolab.cz/. Accessed 14 March 2014

Vojta J (2007) Relative importance of historical and natural factors influencing vegetation of secondary forests in abandoned villages. Preslia 79(3):223–244

Vondruška V (1984) Vliv přírodních podmínek na základní orientaci rustikálního zemědělství v Čechách v 1. polovině 19. století. Československý časopis historický 32(1):78–100

World Atlas of Agriculture (1969) Land utilization maps and relief maps. FAO, Instituto Geografico de Agostini, Rome

Worster D (1979) Dust bowl: the Southern plains in the 1930s. Oxford University Press, New York

Worster D (1986) Rivers of empire: water, aridity, and the growth of the American West. Pantheon Books, New York

Worster D (1990) Transformation of the earth: toward an agroecological perspective in history. J Am Hist 76(4):1087–1116

http://www.springer.com/978-3-319-17670-3

Land Use Changes in the Czech Republic 1845–2010
Socio-Economic Driving Forces

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2015, VII, 215 p. 102 illus., 95 illus. in color., Hardcover
ISBN: 978-3-319-17670-3